EXPERIMENTAL EVIDENCE OF SOURCE PREFERENCE:

Home Bias Explained by Familiarity, Not Ambiguity

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Abstract

The source preference hypothesis of Fox and Tversky (1995) posits that people may have preference between equally distributed risks depending on the underlying source of uncertainty. Using a novel trailing digit design, we identify familiarity bias that is free from other confounds such as ambiguity aversion or information advantage. The first set of four experiments show familiarity bias in portfolio choice, valuation of stocks, and market indices. In a further experiment using real-life investors in Hong Kong, we find evidence of subjects' home bias in stock holding being linked to familiarity bias but not to ambiguity aversion.

Keywords: Source Preference, Familiarity Bias, Home Bias, Ambiguity Aversion, Investment

JEL Classification Codes: D81 (Criteria for Decision-Making under Risk and Uncertainty), C91 (Laboratory, Individual Behavior)

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1. INTRODUCTION

The international equity home bias (French and Poterba, 1991), an important puzzle in finance, refers to the stylized fact that investors allocate disproportionally high weights on domestic stocks in their portfolio – the low degree of diversification is difficult to rationalize under classical finance theory. Subsequently, Coval and Moskowitz (1999), Huberman (2001), Ivković and Weisbenner (2005), Zhu (2003), and Seasholes and Zhu (2010) [1] demonstrate that the puzzle also applies to portfolio of domestic stocks of US investors, and similar result is observed with investors from Finland (Grinblatt and Keloharju, 2001), mainland China (Feng and Seasholes, 2004), and Sweden (Massa and Simonov, 2006).

Many papers have attempted to explain why investors exhibited home bias.[2] It is widely accepted that explanations based on transaction cost or capital control are difficult to reconcile with the high volume of cross-border capital flows and high turnover rate on foreign equity investments relative to turnover on domestic equity markets (see, e.g., Tesar and Werner, 1995). Another explanation is that investors have superior information on domestic stocks or economic conditions (Brennan and Cao, 1997; Pástor, 2000; and Portes, Rey, and Oh, 2001). Van Nieuwerburgh and Veldkamp (2009) model information advantage of home investors based on their choice of what information to acquire based on their comparative advantage of information on home assets. However, there is mixed empirical evidence. Ivković and Weisbenner (2005) and Massa and Simonov (2006) find supportive evidence on superior information of local investors while Seasholes and Zhu (2010) find no evidence of that. Ivković and Weisbenner (2005) find that "average household generates an additional annualized return of 3.2% from its local holdings relative to its nonlocal holdings, suggesting that local investors can exploit local knowledge." Hence, locality bias stems from information rather than familiarity. Using investor data from Sweden, Massa and Simonov (2006) find that local bias is information driven. On the other hand, using the same dataset as Ivković and Weisbenner (2005) but with different analysis method, Seasholes and Zhu (2010) find that "purchases of local stocks significantly underperform sales of local stocks", suggesting that local investors do not hold superior information.

[1] They analyzed the geographic distribution of shareholders of the U.S. Regional Bell Operating Companies and found that a customer of a regional Bell company is more likely to his local bell company than in a bell company in another area.

[2] See Lewis (1999) for an extensive review.

Another strand of the literature on home bias emphasizes the role of ambiguity aversion (Ellsberg, 1961). Uppal and Wang (2003) demonstrate how ambiguity aversion[3] can lead to under-diversification and hence home bias.[4] In the empirical literature, the relationship between ambiguity aversion and investment behavior (stock market participation and home bias) is mixed. Dimmock, Kouwenberg, Mitchell, and Peijnenburg (2016) experimentally elicit ambiguity attitude of US investors and find that ambiguity averse investors are more likely to exhibit home bias. In a study with clients of a French financial institution, Bianchi and Tallon (2019), find that ambiguity averse investors tend to exhibit home bias. However, in a study with Dutch investors, Dimmock, Kouwenberg, and Wakker (2016) do not find significant effect of ambiguity aversion (experimentally elicited) on stock market participation decision.

Ambiguity aversion is related to the idea of source preference, proposed by Fox and Tversky (1995) and axiomatized in Chew and Sagi (2008), in which equally distributed risks may not be indifferent.[5] Fox and Tversky (1995) observe a familiarity bias in source preference using UC Berkeley undergraduate subjects – betting on a less than even-chance event based on San Francisco temperature is preferred to betting on a better than even-chance event based on Istanbul temperature. Subsequently, familiarity bias has been further tested and validated in Chew et al. (2008),[6] and Abdellaoui et al (2011). These findings prompt follow up works in Chew, Ebstein, and Zhong and Chark, et al (2021) to explore the neurobiological basis for familiarity bias.[7]

[3] Ellsberg (1961) observes that people tend to be ambiguity averse in preferring to bet on the urn with known probabilities rather than one with unknown probabilities. The phenomenon of ambiguity aversion is puzzling. People tend to be indifferent between betting on red or black for either urn so drawing either color ought to have the same subjective probability of one-half, regardless of the urn used. Over the past several decades, ambiguity aversion has inspired an active literature in decision theory beyond the subjective expected utility model, e.g., by using a non-additive generalization of probability see e.g., and by assuming that decision makers have a set of prior probabilities in the absence of unique well-defined subjective probability .

[4] More generally, many papers have used the concept of ambiguity to model investors behavior such as for market non-participation (Dow and Werlang 1992, Cao et al., 2005), diversification (Boyle et al., 2012), and information processing (Epstein and Schneider, 2008). See Epstein and Schneider (2010) for an extensive review of theoretical models of ambiguity aversion and its implications for portfolio choice, home bias, and asset pricing.

[5] This idea is traceable to Keynes (1921) who writes, – "If two probabilities are equal in degree, ought we, in choosing our course of action, to prefer that one which is based on a greater body of knowledge?"

[6] Chew et al. (2008) investigate familiarity bias using parity of the trailing digit of the price of a stock to construct even-chance bets of varying levels of familiarity and extend the earlier finding from ambiguity aversion to familiarity bias.

[7] Chew, Ebstein, and Zhong (2012) find associations between ambiguity aversion and familiarity bias with candidate serotonin genes related to anxiety and fear. Chark et al (2021) find a gene-brain-behavior basis of familiarity bias linking it with GABA and amygdala.

In this paper, besides ambiguity aversion, we apply familiarity bias in source preference (Fox and Tversky, 1995; Chew and Sagi, 2008; Abdellaoui et al 2011) to account for home bias in financial markets (French and Poterba, 1991). We document how home bias may be due to familiarity bias that is free from other potential confounds such as information advantage or ambiguity aversion. We find supportive evidence with investors from Hong Kong, Shanghai, and Germany, in laboratory as well as with real-life investors. In the context of home bias, an investor in the lab setting exhibits familiarity bias if she prefers to invest in "home/local" market stocks rather than foreign/non-local stocks, when the risk associated with the two markets are identical. We then examine if the familiarity bias observed in the lab can predict home bias in portfolio choice. Our familiarity bias explanation is distinct from the account based on ambiguity aversion. The investor may exhibit home bias even if she does not perceive ambiguity when investing in foreign stock markets. That is, the investor holds the belief that the expected return of investment in home and stock markets are identical.

This paper reports the results of five interrelated experiments to investigate familiarity bias as an explanation for home bias. The first set of two experiments investigates familiarity bias in portfolio choice and valuation of stocks using laboratory experiments using odd-even design where the payoff of the stocks depend on the trailing digit is odd or even.[8] Using the trailing digit design, it offers an ideal way to identify familiarity bias that is free from other confounds. This is followed by another set of two experiments on home bias involving different exchanges. The fifth and final experiment is a field study on home bias with real-life investors.

In the first experiment, subjects are each asked to form a portfolio involving stocks on the Frankfurt Stock Exchange with different degrees of familiarity in which the payoffs of bets on the 3 unfamiliar stocks dominates those of the 4 familiar stocks. Subjects chose three experimental stocks derived from seven actual stocks listed in the Frankfurt Stock Exchange. An experimental stock pays R times the points invested when the subject guesses correctly the parity of the trailing digit of the closing price of that stock on a randomly chosen date, and zero otherwise. The return factor R equals 2.5 for the familiar stocks (Volkswagen, Lufthansa, and Puma) and equals 2.7 for the three unfamiliar stocks (Pfleiderer, IVG, and Homag), and equal 2.5 for the unfamiliar stock Wacker. The inclusion of Wacker served to identify inattentive

[8]Odd-even in the trailing digit is considered equally likely in the sense of almost-objective uncertainty (Machina, 2004).

subjects who may choose unfamiliar yet dominated stocks. A subject who invested in Wacker can be considered as violating first order stochastic dominance. This will then allow us to estimate the proportion of subjects who invest in familiar stocks is due to conscious choices driven by familiarity bias or inattention (Sims, 2003; Peng and Xiong, 2006). Subjects may be inattentive and invest in Wacker or familiar stocks as attention demands cognitive resources. Hence, investment in Wacker can serve as a measure subject's inattention.

The second experiment uses an ascending clock auction to elicit subjects' willingness to pay for even-chance lotteries different degrees of familiarity. These two experiments help pin down the phenomenon of familiarity bias –familiar stocks tend to be valued higher.

The third experiment is a field study[9] of whether priority banking customers in a Shanghai bank would tend to favor even-chance risks arising from a home market index – Shanghai Composite Index (SSE) – compared to even-chance risks arising from a foreign market index – Dow Jones industrial Average (DJIA) – which pays more. In the fourth experiment, we elicit subjects' premiums to bet on the trailing digit of DJIA rather than that of the home index of Hang Seng Index (HSI) for five specific tasks – Up, Down, Digit 1, Four digits (2, 4, 6, and 8), and Seven digits (digits 1 – 7). The latter three tasks correspond to 0.1, 0.4, and 0.7 chances of winning based on the tendency of the trailing digit of the stock price to be uniformly distributed (Machina, 2004).

The latter two studies point to the incidence of home bias in the laboratory when the risks of the home and foreign markets are identical and there is no information advantage of subjects in either market. We find that subjects favor bets on home market index over bets on a foreign market index. In a lab-in-the-field experiment based on SSE and DJIA, 18 out of 25 high net-worth subjects in Shanghai choose to bet on SSE paying RMB260 rather than DJIA paying RMB280.[10] The results of the Hong Kong experiment using HSI and DJIA are illustrated in Figure 1 which displays the proportions of subjects choosing to bet on HSI for different increments on the bet on DJIA under conditions of Up, Down, 0.1, 0.4, and 0.7 based on the trailing digit of the two markets on a randomly chosen date in 1994. Under each condition, most subjects bet on HSI when the reward from betting on DJIA and HSI are the same. As the

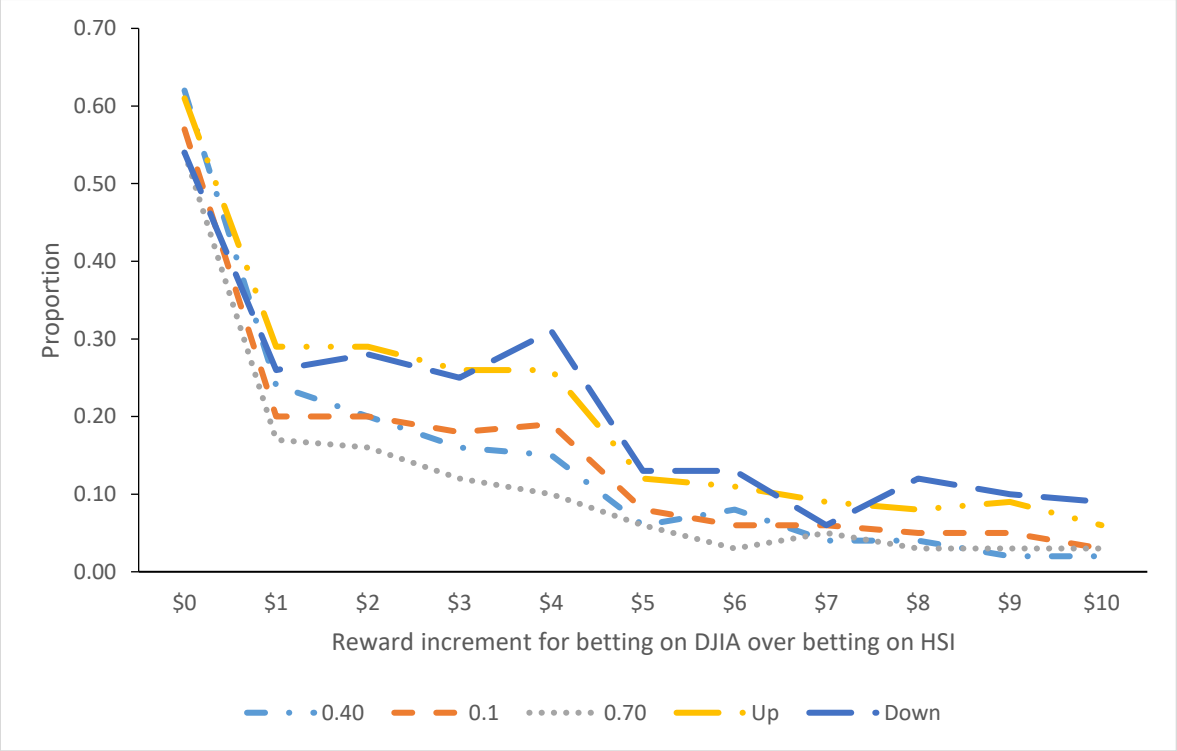
[9] Harrison and List (2004) defined artefactual filed experiment as "same as conventional lab experiment but with a nonstandard subject pool."

[10] At the time of the experiment, 1US$ equals to about 8.11 RMB, 1US$ equals to about HK$7.78, and 1Euro equals to about 1.43 US$.

increment for betting on DJIA increases, the proportion of subjects choosing HSI decreases but remain positive. Observe that the proportions under Up or Down are highest followed by the proportions for betting on 0.1 and 0.4 which tend to exceed those betting on 0.7.

To discriminate between source preference and ambiguity aversion in the Hong Kong study, we elicit subjects' ambiguity attitude and find that the Hang Seng premium – maximum increment subject is willing to forego in betting on HSI rather than DJIA – under Up and Down are both positively correlated with the average premiums under 0.1, 0.4, and 0.7 conditions, but not with ambiguity aversion.

Figure 1. Proportion Betting on HSI over DJIA



The fifth and final experiment is a field study to investigate whether familiarity bias predicts home bias of real-life investors. This consists of a main study with Hong Kong investors and a replication study to test for the robustness of the main study with Hong Kong. In the main study, Hong Kong investors are invited to participate through advertisements in local newspaper. The replication studies involve Hong Kong investors. We elicit investors' source preference via betting on home versus foreign market indices, their ambiguity attitude, as well as whether they hold foreign stocks. The elicitation of source preference and ambiguity aversion helps to

discriminate these two hypotheses of home bias. We find that home bias is positively correlated with familiarity bias but not ambiguity aversion. Taken together, this suggests that home bias is mainly due to source preference rather than ambiguity aversion.

The rest of the paper is organized as follows. Section 2 presents the design and results of the two experiments on familiarity bias in source preference based on individual familiarity ratings for stocks within a home market. This is followed by the design and findings of home bias in Section 3 using domestic versus foreign market indices. Section 4 presents our field study on home bias with real-life investors in Hong Kong. Section 5 concludes with further discussions.

2. EVIDENCE BASED ON FAMILIARITY OF STOCKS

2.1 **Portfolio Choice Experiment**

Design

The experiment consists of two parts. In Part 1, subjects made decisions involving choice of up to three experimental stocks derived from seven actual stocks listed in the Frankfurt Stock Exchange (see Table 1). Part 2 was a questionnaire study about subjects' degree of familiarity towards these seven stocks. Subjects were each endowed with 10,000 points (1,000 points = 1 Euro) and could invest in up to three experimental stocks and between 100 and 10,000 points for each chosen stock. An experimental stock pays R times the points invested when the subject guesses correctly the parity of the trailing digit of the closing price of that stock on a randomly chosen date, and pays zero when the guess is incorrect. The return factor R equals 2.5 for the familiar stocks (Volkswagen, Lufthansa, and Puma) and equals 2.7 for the three unfamiliar stocks (Pfleiderer, IVG, and Homag). To help identify potentially inattentive subjects who may choose unfamiliar yet dominated stocks, we include an unfamiliar stock, Wacker, with R of 2.5 instead of 2.7. The investment in Wacker can be considered as a measure of inattention.

Table 1. List of Stocks in the Portfolio Choice Experiment

Logo	Company Name	R	Familiarity	Stock Price
	Volkswagen	2.5	9.50	113.73
	Puma	2.5	9.12	215.10
	Lufthansa	2.5	9.07	11.60
	Wacker Chemie	2.5	3.60	106.98
	IVG Immobilien	2.7	1.90	6.87
	Homag Group	2.7	1.70	8.30
	Pfleiderer	2.7	1.50	7.03

Notes: R is the return factor. Subject receives R times amount invested if her guess of the parity of the trailing digit of the stock price is correct. The stock prices refer to the price of the stocks at market closing on the selected date.

Classical finance theory has clear predictions for investment behavior in this experiment. Subjects would adopt an equal-share portfolio comprising the three high-return albeit unfamiliar stocks. In this regard, we say that a subject exhibits *familiarity bias* if she includes at least one familiar but dominated experimental stock in her portfolio.

Results

We have conducted two experimental sessions with a total of 60 undergraduate students recruited from Friedrich Schiller University Jena in Jena, Germany. Subjects earned on average 13.3 Euro inclusive of 2.5 Euro in show-up fee. They were informed that their identities and their decisions investing in up to three experimental stocks would be kept confidential. On a scale of 1 (not familiar at all) to 10 (very familiar) in the questionnaire, Volkswagen receives the highest familiarity rating of 9.5, followed by Puma (9.12), Lufthansa (9.07), Wacker (3.60), IVF (1.90), Homag (1.70), and Pfleiderer (1.50).

On average, subjects invested 36.2% of their endowment. We classify the top 3 stocks as familiar and the last four as unfamiliar. Table 2 reports the portfolio compositions of subjects of those holding Wacker, do not hold Wacker, and pooled data.

In the pooled data of those holding Wacker and those not holding Wacker, Table 2 shows that 63.3% (38 out of 60) of subjects exhibit familiarity-based source preference by including at least one familiar but dominated stock; the specific proportions of subjects who include one, two, and three familiar stocks in their portfolios are 30.0%, 18.3%, and 15.0%, respectively.

Table 2 reports the average shares for familiar stocks, unfamiliar stocks, and cash conditional on the number of familiar stocks in the portfolios for the pooled data. It is noteworthy that the shares allocated to cash are similar (not significantly different at $p > 0.1$) regardless of the number of familiar stocks. The prediction of equal-share among three high-return experimental stocks accounts for 36.7% of subjects who invest only in the three unfamiliar stocks – share invested is not significantly different from 1/3 for each stock ($p > 0.1$). With one familiar stock in the portfolio, subjects invest 30.3% (out of total points invested in stocks) in familiar stocks. When there are two familiar stocks (18.3% of subject) in their portfolio, subjects on average invested 74.1% (out of total points invested in stocks) in familiar stocks. Interestingly, the equal-share principle applies to 15.0% subjects who invest only in familiar but dominated stocks. Their shares of investing in their chosen stocks are also not significantly different from 1/3 ($p > 0.1$).

Table 2. Familiarity-specific Portfolio Composition

Number of Familiar Stocks	% of Subjects	% Share of Familiar Stocks	% Share of Unfamiliar Stocks	% Share of Cash
Not Holding Wacker	71.7	14.2	21.2	64.6
0	44.2	0	34.5	65.5
1	20.9	10.4	22.5	67.1
2	14.0	31.3	8.8	59.9
3	20.9	36.4	0	63.6
Holding Wacker	28.3	14.1	24.3	61.6
0	17.6	0	48.3	51.7
1	52.9	12.3	23.3	64.4
2	29.4	25.8	11.4	62.8
3	0			
Pooled		14.2	22.0	63.8
0	36.7	0	36.4	63.6
1	30.0	11.4	22.9	65.7
2	18.3	28.8	10.0	61.3
3	15.0	36.4	0	63.6

We classify those choosing Wacker as inattentive subjects. There are 17 (28.3% out of the total of 60) subjects who invested in Wacker. Among the 48 subjects (63.3%) who have invested in at least one familiar stock, 14 (28.3%) of them invested in Wacker. Thus, we can

infer that majority of subjects (71.7%) who invested in the familiar stocks are not due to inattention but conscious choices.

In terms of how subjects indicated their choice of stocks among the three available slots on the screen (see experimental instruction in Appendix 1), it is interesting to observe that they tended to list the familiar but dominated stocks first taking up the top spot followed by the middle spot. For instance, out of eighteen subjects who held one familiar stock, nine placed it on top, six placed it in the middle, and three placed it at the bottom.

2.2 **Ascending-Price Auction Experiment**

Design

We make use of an ascending-price auction to elicit valuations towards 15 different even-chance lotteries. Each lottery was associated with a particular listed company and its payoff was contingent on whether the trailing digits of closing price of that company one trading day after the experiment would be odd or even. These companies differed in their degree of familiarity perceived by our Hong Kong-based participants (see Table 3). We hypothesize that people have different degree of risk aversion toward the uncertainty arising from different companies. We anticipate that the degree of risk aversion will be negatively correlated with the perceived degree of familiarity.

Twenty-five undergraduate students from the Hong Kong University of Science and Technology were recruited to participate in the experiment. At the beginning, subjects were informed that their decisions, identity, and payoffs would be kept confidential. Subjects received show-up fees of HK$100.

The ascending-price auction was implemented in the following way. At the start of the auction, the experimenter displayed the label of the company and the prize which ranges from HK$91 to HK$100 on the screen. Starting from $5, the price increased continuously with a $5 increment at every 15 seconds. In these 15 seconds intervals, subjects decided whether to stay in the auction. They indicated their intention to leave the auction by pressing the withdraw button. If they want to stay in the auction, they did not need to do anything.[11] Once left, the subject could not re-enter the auction for that item. The auction ended when there was either only one

[11] Subjects could choose to stay in the auction as long as the price was less than HK$100 show-up fee.

remaining bidder or all bidders have left at the new price level. In the latter case, bidders who were active at the previous price level became the winners.

The winner's monetary payoff would equal the payoff from the lottery minus her winning bid plus a show up fee of HK$100. After all 15 auctions, subjects reported their degrees of familiarity towards the brands on a scale of 1 (not familiar at all) to 10 (very familiar). If a subject won more than one lottery, one of them was randomly drawn to implement.

Table 3. Summary Statistics of Familiarity and Risk Attitudes

Sources	Familiarity Rating	Relative Risk Premium
HSBC 滙豐	9.56 (0.71)	0.19 (0.35)
Coca-Cola	9.24 (1.39)	0.20 (0.25)
SONY	8.96 (1.14)	0.31 (0.32)
CATHAY PACIFIC	8.76 (1.30)	0.21 (0.23)
nike	8.76 (1.30)	0.27 (0.24)
	7.96 (2.24)	0.23 (0.30)
Familiar	8.87 (0.12)	0.24 (0.02)
ALCATEL	4.72 (2.95)	0.33 (0.37)
AGFA	3.92 (3.30)	0.54 (0.31)
itv	3.16 (2.61)	0.33 (0.26)
KIA MOTORS	3.16 (2.64)	0.40 (0.41)
easyJet	2.76 (2.57)	0.43 (0.27)
ALPHA BANK	2.48 (2.14)	0.33 (0.27)
TXU Energy	1.80 (1.73)	0.24 (0.29)
STATOIL	1.68 (1.82)	0.36 (0.37)
RIVIERA Tool Company	1.60 (1.50)	0.25 (0.25)
Unfamilar	2.81 (0.17)	0.36 (0.02)

Notes: Subjects report their degrees of familiarity towards the brands (sources) on a scale of 1 (not familiar at all) to 10 (very familiar). Standard deviations are in parentheses.

Results

Column 1 of Table 3 reports the average familiarity rating F_i $(i = 1, \ldots, 15)$ of the 15 sources ranked by their familiarity ratings. Subjects perceive that Hong Kong and Shanghai Bank (HSBC) was the most familiar and Riviera Tool Company is the least. Column 2 of Table 3 reports the relative risk premium of each source. For each subject, her relative risk premium for source i given by $1 - CE_i/(x_i/2)$. We find that the estimated degree of relative risk premium of the familiar

stocks (those with familiarity rating at least equal to 5) is 0.24 which is significantly lower than 0.36 for the unfamiliar stocks (those with familiarity rating less than 5), $p = 0.00$.[12]

Table 4. Familiarity and Relative Risk Premium

	Relative Risk Premium
Constant	0.62
	(0.41)
Familiarity	-0.02***
	(0.003)
Outcome	-0.002
	(0.004)
Round Number	-0.01**
	(0.003)
Winning Dummy	0.06
	(0.06)
# of Obs.	375
Adjusted R^2	0.41

Notes: This table reports OLS regression where the dependent variable is relative risk premium. There are four explanatory variables: (i) *Familiarity* is subject *i*'s self-reported rating of familiarity towards brand *r*, *Outcome* is the reward size of the lottery in round *r*, *Round Number* is number of round, and *Winning Dummy* is a dummy for subject *i* which equals 1 for the rounds of auction for which *i* wins in round *r*, and zero otherwise. The regression is run using the areg command in Stata with subject as the category factor. This is equivalent to adding a dummy for each subject, but the value of each dummy is not shown. *,**,*** denote significance at $p < 0.1$, 0.05, and 0.01 (two-tailed) respectively.

Column 1 of Table 4 reports the results of the OLS regression where relative risk premium is regressed on the degree of familiarity, controlling for reward size, round number, if the subject has won in previous auctions, and individual fixed effects. The coefficient on familiarity is significantly negative ($p < 0.01$), implying that the relative risk premium is negatively correlated with familiarity.

2.3 **Summary**

In summary, the portfolio experiment shows that subjects hold portfolio that is consisted with familiar but dominated stocks. This can be explained by the fact that subjects have higher valuation towards more familiar stocks as shown in the auction experiment. This supports the familiarity bias explanation rather than information advantage (Nieuwerburgh and Veldkamp, 2009).

[12] The classification of familiar stocks and unfamiliar stocks is based on the mean familiarity rating of 5.2.

Result 1. Subjects value more familiar stocks higher and investing in them disproportionately.

3. EVIDENCE BASED ON HOME VERSUS FOREIGN MARKET INDICES

3.1 **Shanghai Stock Exchange Index versus Dow Jones Industrial Average**

Design

We conducted an artefactual field experiment by recruiting twenty-five high net worth investors at a Shanghai bank. The subjects made binary choices from the following pairs of lotteries based on the parity (odd-even) of trailing digit and up-down of the Shanghai Stock Exchange Index (SSE) and the Dow Jones industrial Average (DJIA) at closing the next business day:

Pair 1. Shanghai (odd-even; pays RMB 250) vs. Shanghai (up-down; pays RMB 250)

Pair 2. Dow Jones (odd-even; pays RMB 250) vs. Dow Jones (up-down; pays RMB 250)

Pair 3. Shanghai (odd-even; pays RMB 260) vs. Dow Jones (odd-even; pays RMB 280)

Pair 4. Shanghai (up-down; pays RMB 260) vs. Dow Jones (up-down; pays RMB 280)

After making their choices, subjects specify if they want to bet specifically on odd versus even and on up versus down.

Table 5. Shanghai Field Experiment

	Payoffs	Up-down	Odd-even
Pair 1	SSE (odd-even; pays RMB 250) vs.	16	9
	SSE (up-down; pays RMB 250)	(8,8)	(5,4)
Pair 2	DJIA (odd-even; pays RMB 250) vs.	17	8
	DJIA (up-down; pays RMB 250)	(9,8)	(4,4)
		SSE	DJIA
Pair 3	SSE (odd-even; pays RMB 260) vs.	18	7
	DJIA (odd-even; pays RMB 280)	(13,5)	(1,6)
Pair 4	SES (up-down; pays RMB 260) vs.	21	4
	DJIA (up-down; pays RMB 280)	(14,7)	(3,1)

Notes: The respective numbers of subjects choosing Odd versus Even (Up versus Down) under Odd-even (Up-down) are indicated in parentheses using (x, y).

Results

Table 5 reports the results of this experiment. The result for Pair 3 is particularly striking. Out of 25 subjects, 18 choose to bet on the dominated SSE lottery. This is significantly different from chance ($p < 0.04$) using the binomial test. For Pair 4, 21 out of 25 subjects prefer betting on the dominated SSE lottery. For Pairs 1 and 2, nominally more subjects bet on up-down than odd-

even although the differences are not significantly different from chance ($p > 0.1$). Pooling the data for both pairs, the proportion choosing up-down is marginally higher ($p < 0.07$) according to the binomial test.

3.2 **Hang Seng Index versus Dow Jones Industrial Average**

Design

Subjects participated in a series of games in which their source preferences under different degrees of risk, and uncertainty are elicited. For the games on source preference under risk, there are 3 games which differ in terms of winning probabilities. In particular, 0.1, 0.4, and 0.7, respectively. In these games, subjects were asked to choose between betting on the last digit of DJIA versus HSI. Two games under uncertainty where winning probabilities are unknown were conducted. In the Up (Down) condition, subjects were asked to choose between betting on whether DJIA or the HSI was up (down). This design enables the elicitation of a Hang Seng Premium in terms of the maximum increment that he/she is willing to forego in betting on HSI rather than DJIA. We explain the details of the games as follows.

10% Condition. Subjects make a series of 11 choices in which they choose between betting on the trailing digit of the closing of the HSI or DJIA on 1994-12-14 being 1 (i.e., winning probability is 10%).[13] If they choose to bet on HSI (DJIA), the subject receives HK$20 (HK$20 + $x, where $x is the reward increment which equals to 0, 1, 2, 3, … ,10, respectively) if the last digit is 1, and receive $0 otherwise.

40% (70%) Condition. The condition here is the same as the *10%* condition except that subjects win if the trailing digit of the chosen index was 2, 4, 6, or 8 (1, 2, 3, 4, 5, 6, or 7) on 1994-12-13 (1994-12-15).

Up (Down) Condition. Subject wins if index was up (down) on 1994-12-16 (1994-12-19).

Ambiguity Attitude. We elicit subjects' ambiguity attitudes based on their choice between two bags. Bag 1 contains 50 cards numbered from 1 to 50. Bag 2 contains 50 cards. Each card is numbered between 1 and 50 inclusive, but the exact distribution is not known. The payoff from

[13] The date in this condition and the other conditions were randomly chosen from dates that the stock markets were open.

choosing a bag equals the number of the card drawn from that bag. Ambiguity aversion corresponds to the subject choosing bag 1 over bag 2.

We recruited 93 subjects who were undergraduate students from the City University of Hong Kong. They received a show-up fee of HK$40 plus a payoff contingent on the choices made during the experiment. Subjects were informed that their choices would be kept confidential. Three sessions of the experiment were conducted in the laboratory with partitioned seats. At the end of a session, one of the choices made was randomly drawn for payment. There was no feedback in between choices.

Results

As exposited in the Introduction, Figure 1 shows that Hong Kong subjects tend to prefer betting on HSI over betting on DJIA. This is evident from observing that a majority of subjects chose to bet on HSI – 0.57, 0,62, 0.57, 0.61, and 0.54 for conditions 0.1, 0.4, 0.7, Up, and Down, respectively – when there is no difference in payoffs between the two bets. While the proportions choosing HSI decrease as the increment for betting DJIA increases, it is striking that they remain above 5% up to increments of HK$4, HK$4, HK$4, HK$6, and HK$9 for the respective conditions of 0.1, 0.4, 0.7, Up, and Down. Table 6 below displays the means and standard deviations of the corresponding Hang Seng premiums.

Table 6. Summary Statistics for Hang Seng Premium

Conditions	Mean (Std. Dev.)
Up	2.55 (0.34)
Down	2.70 (0.37)
0.1	1.86 (0.30)
0.4	1.92 (0.28)
0.7	1.38 (0.24)

Table 7 shows that the differences among the average differences in premiums are in line with what is displayed in Figure 1. While the Hang Seng Premiums for Up and Down are similar, they each significantly exceeds the premiums of conditions 0.1 and 0.4 which are also similar and they each significantly exceeds the premium under condition 0.7.

Table 7. Comparison of Hang Seng Premiums

Pairs	Mean Difference	*p*-value
Up vs. Down	- 0.15	0.69
Up vs. 0.1	0.69	0.02**
Up vs. 0.4	0.62	0.03**
Up vs. 0.7	1.17	0.00***
Down Vs. 0.1	0.84	0.01**
Down vs. 0.4	0.77	0.03**
Down vs. 0.7	1.32	0.00***
0.1 vs. 0.4	-0.06	0.79
0.4 vs. 0.7	0.55	0.05**
0.1 vs. 0.7	0.48	0.07*

Notes: *, **, *** denotes significance at 10%, 5%, and 1 % levels, respectively.

Ambiguity Aversion. It was found that 43% of subjects are ambiguity averse. Table 8 compares the Hang Seng Premiums between the ambiguity averse and non-ambiguity averse subjects for the 5 conditions of Up, Down, 0.1, 0.4, and 0.7. The only significant difference was found under condition 0.4.

Table 8. Hang Seng Premium for Ambiguity Averse vs. Non-Ambiguity Averse Subjects

Conditions	Non-Ambiguity Averse	Ambiguity Averse	Mean Difference	*p*-value
Up	2.29	2.73	-0.44	0.53
Down	2.87	2.58	0.29	0.70
0.1	1.45	2.15	-0.70	0.25
0.4	1.08	2.51	-1.43	0.01***
0.7	1.16	1.53	-0.37	0.46

Notes: *, **, *** denotes significance at 10%, 5%, and 1% levels, respectively.

Column 1 of Table 9 reports the OLS regression where the dependent variable is Hang Seng Premium (Up) and the independent variables are average of premium in 0.1, 0.4, and 0.7 conditions, and ambiguity aversion (which is a dummy that the subject is ambiguity averse, zero otherwise). We find that the coefficient on the average premium is significantly positive while the coefficient on ambiguity aversion is not significant. A similar pattern is observed for the regression on Hang Seng Premium (Down) as reported in column 2 of Table 9. If we consider Hang Seng Premium (Up) and Hang Seng Premium (Down) as a proxy of classical home bias where probability is unknown, our analysis suggests that classical home bias is mainly explained

by source preference rather than ambiguity aversion. We do not observe correlation between ambiguity aversion and Hang Seng premium in the laboratory experiment reported in subsection 3.2 except for the 0.4 condition.

Table 9. Determinants of Hang Seng Premium under Up and Down

	(1) Up	(2) Down
Average Premium	1.08***	0.96***
	(.11)	(.14)
Ambiguity Averse	-0.46	-1.08*
	(.50)	(.62)
Constant	0.96**	1.70***
	(.40)	(.50)
# of Obs.	93	93
R^2	0.51	0.34

Notes: This table presents the OLS regressions on Hang Seng Premium (Up) and Hang Seng Premium (Down). Average premium is the average of Hang Seng premium for 0.1, 0.4, and 0.7 conditions. Ambiguity averse is a dummy that equals 1 if the subject ambiguity averse, zero otherwise. *, **, ***, denote significance at 10%, 5%, and 1% levels, respectively.

3.3 Summary

Hong Kong subjects prefer to bet on the home market indices, and the strength of the preference measured in terms of Hang Seng premium is stronger when betting on Up, and Down than conditions 0.1, 0.4, and 0.7. The Han Seng premium is not correlated with ambiguity aversion, suggesting that the preference is not due to ambiguity aversion. This suggests that familiarity bias observed is not driven by ambiguity aversion or information advantage on Hang Seng index.

Result 2. Subjects exhibit familiarity bias in having home premium between betting on the trailing digit of the home market index versus the corresponding bets on the foreign market index.; home premium is not correlated with degree of ambiguity aversion.

4. FIELD STUDY ON HOME BIAS OF REAL-LIFE INVESTORS

Design

We conduct the online incentivized experiment with real-life investors in Hong Kong. We recruited the subjects via an advertisement in a major newspaper in Hong Kong. In total, 813 subjects completed the survey, and each subject was required to submit a bank statement. Among

them, 349 subjects submitted their bank statements.[14] Subjects received HK$100 for participation plus payoff from one randomly drawn game.

The online experiment consists of two parts. In the first part, we elicit the subject's familiarity bias (source preference) for investing in the local market index (i.e., Hang Seng Index) vs. foreign market index (i.e., Dow Jones). In the second part, we elicit the subject's ambiguity aversion attitude, and other control measures including social identity, strategic thinking (P beauty contest game), and info of subject's portfolio in real-life including whether holding foreign stock, and other demographic information.

Familiarity Bias. Two games were played, the odd-even game, and the up-down game. In the odd-even game, subjects choose between betting on whether the last digit of Hang Seng index and Dow Jones index on a specified trading day (10 days from the date of the online experiment) was odd or even. If the subject chooses to bet on Hang Seng and win, he will receive HK$20, zero otherwise. If the subjects choose to bet on Dow Jones and win, he will receive HK$22. Since the subjects are betting on odd-even, the objective chance of winning is the same between Hang Seng and Dow Jones. In the up-down game, the design is the same, except that subjects now bet on whether the stock price is up or down on a particular trading date.

Ambiguity Aversion. We elicit the subject's valuation towards risky lottery and ambiguous lottery. In the risky lottery, there is a bag that contains 50 cards, each card is marked with one integer, from 1 to 50. That is, there is 1 card with 1, 1 card with 2, and so on. In a menu of choices, subjects were asked to choose between playing the lottery and receiving a sure amount ranged from HK$2 to HK$40. If the subject chooses to play the lottery, a card will be drawn and his payoff will be equal to the number drawn. The subject's valuation for the risky lottery is equal to the lowest amount that the subject chooses to receive the sure amount. Subject's valuation for the ambiguous lottery is elicited in the same way as the risk lottery except that in the bag of the ambiguous lottery the distribution of cards is unknown (while it is known that the lowest number is 1, and the highest number is 50. A subject is said to exhibit ambiguity aversion if her valuation for the risky lottery is higher than the ambiguous lottery.[15]

[14] For the purpose of this paper, we focus on analyzing decisions of subjects who submitted the statements.
[15] As a robustness check, we conducted another online experiment to check the relationship between ambiguity aversion elicited using our experimental task, and also the other design where the risky bag contains 50 cards (25 red

As robustness check, we conduct a replication study of the main experiment using real-life investors in Hong Kong.[16] The design of the replication study is similar to that of the main study except for the elicitation of ambiguity aversion which uses the classical design.[17]

Results

Table 10 reports the descriptive statistics. Among the 349 subjects, it is found that 53% chose to bet on Hang Seng when betting on odd-even, and 57% of subjects chose to bet on Hang Seng when betting on up-down, both are significantly different from zero. About 39% of subjects are found to be ambiguity averse, and 92% of subjects exhibited home bias, based on answers in the survey about whether one holds foreign stocks.[18]

Table 10. Descriptive Statistics of Online Field Study with Real-life Investors

Main Experiment in Hong Kong	Proportion	t-test (null hypothesis = 0) *p*-value
Bet on Hang Seng (odd-even)	0.53	0.00
Bet on Hang Seng (up-down)	0.57	0.00
Ambiguity Averse	0.39	
Home Bias	0.92	
Replication Study in Hong Kong	Proportion	
Bet on Hang Seng (odd-even)	0.31	0.00
Bet on Hang Seng (up-down)	0.25	0.00
Ambiguity Averse	0.43	
Home Bias	0.91	

Column 1 of Table 11 reports the marginal effect coefficient estimates of Probit regressions where the dependent variable is not holding foreign stock in the actual portfolio (i.e.,

and 25 black), while the ambiguity bag contains 50 cards but with unknown distribution of red and black. It was confirmed that the ambiguity aversion elicited under the two designs are correlated.

[16] For the replication study, subjects receive a participation fee of HK$200 plus a payoff from one randomly drawn game. To be eligible for payment, subjects submit 12 months of investment statements for the year 2017-18. (127 out of 200 uploaded their statements).

[17] We elicit the subject's valuation towards risky lottery and ambiguous lottery. In the risky lottery, there is a bag containing 25 red cards and 25 green cards. In a menu of choices, subjects choose between playing the lottery and receiving a sure amount ranging from HK$2 to HK$20. If the subject chooses to play the lottery, a card will be drawn and his payoff will be equal to the specified amount if the red card if drawn, zero otherwise. The subject's valuation for the risky lottery is equal to the lowest amount that the subject chooses to receive the sure amount. Subjects' valuations for the ambiguous lottery are elicited in the same way as for the risky lottery except for not knowing the proportion of the colors in the bag for the ambiguous lottery. A subject is said to exhibit ambiguity aversion if the risky lottery is valued higher than the ambiguous lottery.

[18] This degree of home bias is consistent with the empirical findings in the literature that investors allocate a very large weight of their portfolio to local stocks.

exhibiting home bias in actual portfolio) based on answers in the survey about whether one holds foreign stocks. Familiarity bias is a dummy that equals one if the subject prefers to bet on Hang Seng (odd-even) in the experiment, zero otherwise.[19] Ambiguity averse is a dummy which equals to one if the subject exhibits ambiguity aversion, zero otherwise. In the experiment, it is found that home bias is positively correlated with familiarity bias, but not significantly correlated with ambiguity aversion. We also find no significant correlation between familiarity bias and ambiguity aversion.

Table 11. Determinants of Home Bias

	Dependent variable: Home Bias	
	(1) Main Experiment (Hong Kong)	(2) Replication Study (Hong Kong)
Familiarity Bias	0.056**	0.056**
	(0.028)	(0.022)
Ambiguity Averse	0.024	0.002
	(0.027)	(0.027)
Identity	-0.001	0.001
	(0.001)	(0.001)
Trust on Local Company	0.001*	0.000
	(0.001)	(0.001)
Probability Bias (Odd-Even)		-0.095*
		(0.053)
Weak Strategic Thinking	0.018	0.026
	(0.027)	(0.033)
Confidence	-0.032	-0.178**
	(0.061)	(0.070)
Pseudo R-squared	0.05	0.26
# of Obs.	349	127

Notes: This table reports the marginal effect coefficient estimates of probit regressions where the dependent variable exhibiting home bias. Familiarity bias is a dummy that equals to one if the subject exhibits home bias (odd-even) in the experiment, zero otherwise. Identity is the degree of self-rated strength of being a Hong Konger (main study, replication study in Hong Kong). Probability Bias (Odd-Even) is a dummy which equals 1 if the subject does not hold the belief that the chance of winning on HS is the same as DJ, zero otherwise. Weak strategic thinking is a dummy that equals one if the subject submits a number higher than 50 in the beauty contest game, zero otherwise. Confidence is the degree of self-reported chance that his/her investment in the coming year will beat the market. *, **, ***, denotes significance at 10%, 5%, and 1% levels, respectively.

[19] We use the choice in the odd-even game to identity source preference as this is the purest measure in the sense that it is most unlikely that subjects may believe that they have information (as compared to betting on up-down)

Replication study. Table 10 reports the descriptive statistics of the replication studies. When betting on odd-even, 31% of subjects choose to bet on Hang Seng while its payoff is dominated by Dow Jones. When betting on up-down, 25% of subjects choose to bet on Hang Seng while its payoff is dominated by Dow Jones, and the proportion is significantly higher than zero. It is found that 91% of subjects exhibited home bias in their actual portfolios (based on the response to the question on whether they hold foreign stocks). About 43% of subjects are ambiguity averse. In general, we observe consistent pattern of familiarity bias and home bias in the replication study as in the main study.[20]

Columns 2 of Table 11 display the marginal effect coefficients estimations of the Probit regression, where the dependent variable is not holding foreign stocks in the actual portfolio, on the chance that the subject exhibits home bias in actual equity holding for the Hong Kong replication study. It is found that home bias is positively correlated with familiarity bias, but not ambiguity aversion, a result consistent with the main study.

Our overall finding of an association between familiarity bias and home bias and type of experiment (laboratory with student subjects and field study with real-life investors) appears to be robust. At the same time, we do not find correlation between home bias and ambiguity aversion suggesting that its effect in accounting for home bias may not be as robust as previously reported in the literature (see, e.g., Dimmock, Kouwenberg, Mitchell, and Peijnenburg, 2016). Summarizing, we have:

Result 3. Home bias based on holdings of real-life investors is correlated with their degrees of familiarity bias but not with their ambiguity attitudes.

[20] While there is no significant difference in terms of proportion not holding foreign stocks, subjects of the replication study on average hold significantly (p-value = 0.01 under two-sample t-test) higher percent of foreign stocks (4.5%) than in the main study (1.6%). They are significantly (p-value = 0.01 under two-sample t-test) less likely to exhibit familiarity bias, more risk averse (p-value = 0.03 under two-sample t-test). There are no significant differences in terms of ambiguity aversion, age, self-rated strength of being a Hong Konger, trust on local company, and weak strategic thinking. Subjects in the replication study on average had portfolio size of HK$417,061 which is not significantly different from HK$421,482 of the main study.

5. CONCLUDING REMARKS

We have experimentally identified familiarity bias towards individual stocks and on whether a market index is home or foreign. Using a novel trailing digit design, we generate bets with well-defined risks using the trailing digit of the corresponding stock price or market index. This design allows us to measure familiarity bias that is free from other potential confounds such as ambiguity aversion or information advantage. A consistent finding from the experiments is that individuals are less risk averse when taking on more familiar or home-based risks. This phenomenon appears to be robust to variations in the specific setting (laboratory experiment and field experiment), subject pool (students and real-life investors), location (Germany, China, and HKSAR), and elicitation method (auction, binary choice, and choice list). In terms of the size of the premium, the portfolio choice experiment in Germany and the SSE-DJIA field experiment in Shanghai suggest that it is at least 7%. The Hong Kong auction experiment finds that it is about 12%. The HSI-DJIA suggests that it is about 25.5%, 27%, 18.6%, 19.2%, and 13.8% for the Up, Down, 0.7, 0.4, and 0.1 conditions respectively. The portfolio experiment shows that investing in familiar stocks is due to conscious choice rather than random choice or inattention. Taken together, the results point to significant familiarity and home market premiums. In the fifth study, we find that home bias of real-life investors is positively correlated with familiarity bias but not ambiguity aversion.

Our study offers the first evidence on familiarity bias as a channel for home bias, that is free from ambiguity aversion or information advantage, in the field as well as in a laboratory setting. A consistent finding is that source preference rather than ambiguity aversion or information advantage is the key driver for home bias. This corroborates the findings in Coval and Moskowitz (1999) and Huberman (2001) of market-level home bias in the domestic US equity markets and complements the more recent finding in Dimmock, Kouwenberg, Mitchell, and Peijnenburg's (2016) of a role for ambiguity attitude in accounting for home bias. In a follow-up paper, Chew and Li (2021) apply our source premium approach in conjunction with social preference to model investors' preference towards ESG (Environmental, Social, and Governance) investment. Complementing the emergence of experimental evidence on source preference in terms of familiarity and home bias, incorporating source preference appears to offer a fruitful direction of further research to extend existing models of asset pricing and portfolio choice.

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APPENDIX 1 (FOR ONLINE PUBLICATION)

Experimental Instructions of the Portfolio Choice Experiment

The experiment was conducted in German language, and the original instructions were also in German (available upon request).

Welcome to our experimental study on decision-making. Each participant will receive a participation fee of 2.5 Euro at the end of the experiment. In addition, each participant will have the chance to earn more money according to the instructions below.

Your identity

You have been given a subject ID number. Please keep it confidentially. Your decisions will be anonymous and kept confidential. Thus, other participants won't be able to link your decisions with your identity. You will be paid in private, using your subject ID, and in cash at the end of the experiment.

When you have any questions, please feel free to ask by raising your hand, one of our assistant will come to answer your questions. Please DO NOT attempt to communicate with any other participants.

==========

You are endowed with 10000 points (1000 points = 1 Euro). You can invest any point between 0 and 10,000 on a portfolio formed by yourself. The portfolio is consisted of 2 parts: cash and 3 stocks. You need to decide how many points to keep as cash holding, and how many points to invest in the 3 stocks chosen by yourself. For the investment in the stocks, you need to choose 3 stocks from the following 7 stocks in Table 1 to form the stock holdings, and also decide how many points to invest in each chosen stock (you need to invest at least 100 points for each of the 3 stocks chosen). All stocks are listed in the Frankfurt Stock Exchange. For each stock chosen, you also need to bet on whether the last digit of the closing price of that stock on 2009-10-23 is odd or even.

Table 1. Stocks

Logo	Company Name	Stock Code	R
	Volkswagen AG St	239	2.5
	Pfleiderer AG	134	2.7
	IVG Immobilien AG	532	2.7
	Deutsche Lufthansa AG	342	2.5
	Homag Group AG	131	2.7
	Puma AG	332	2.5
	Wacker Chemie AG	423	2.5

The return on the stocks will be determined in the following way. If the odd-even outcome of the stock is the same as your bet, you will receive R times of the amount invested in that stock (The value of R is tabulated in Table 1). If not, you will loss the amount of points invested in that stock. That is, if you invest *x* points and win, you will receive R* *x* points. If not, you will loss *x* points.

At the end of the experiment, you will receive the payment in cash according to the outcome of your portfolio.

Your Decision

This is the written instruction. You will specify your decisions using the computer terminal.

Cash [ ] **points**

	Stock Code	Points	Odd	Even
Stock 1	[ ]	[ ]	○	○
Stock 2	[ ]	[ ]	○	○
Stock 3	[ ]	[ ]	○	○

Instructions for Auction Experiment

Study of Decision Making

Prof. CHEW Soo Hong
Economics department & cEBR

funded by

the **University Grants Committee**

of Hong Kong Government

ATTETION

- During the study,
  please do NOT talk to each other.
- If you have any questions, please raise your hand.
- We will take your questions privately.
- Answers to all relevant questions will be announced publicly.

Instructions

- This experiment will have 15 rounds of auctions. Each round is independent of the others.
- In each round, you will bid for a lottery based on the last digit of the closing price of a particular listed company in tomorrow. Specifically:
  - If the last digit turns out to be odd, you will receive $Y (This amount will be announced in the beginning of each auction round.)
  - If the last digit of the closing price of the stock is even, you will receive nothing.

Auction rule

- At the start of each auction round, we will display the label of the stock and the reward amount on screen.
- The experimenter will announce the price level starting at $5. You will have 15 seconds to decide whether to stay in the auction. in case you decide to remain in the auction round, you don't need to press any button on your PRS.
- If you decide to leave the auction round, please press 1 on your PRS. Once you leave the auction round, you can not re-enter.
- After 15 seconds, the experimenter will proceed to

Auction rule

announce the next price level.

Auction rule, continued

- At any price level, as long as there are two or more remaining bidders, the price will be increased by $5. Again, if you decide to remain, you don't need to press any button. Otherwise, you can press "1" to indicate your decision to leave the auction round.

Auction rule, continued

- The auction round ends when there is (i) one remaining bidder or (ii) no remaining bidders.
- Case (i): The sole remaining bidder receives the lottery at the prevailing price.
- Case (ii): Each of the bidders at the previous price level will receive the same lottery and pay that price.

Your Payoffs

- $100 show up fee.
- If you win more than once, we will randomly draw one round and sell you the lottery you won at the prevailing price.
- Your payoff = The result of the lottery– your bid amount + show up fee $100

Have questions?

Raise your hand!

Do NOT hesitate to ask any questions!

Trial round

APPENDIX 3 (FOR ONLINE PUBLICATION)

Instructions for HSI vs DJIA Experiment

Instructions

Welcome to our experimental study on decision-making. You will receive a show-up fee of $40. In addition, you can gain more money as a result of your decisions in the experiment.

You will be given a subject ID number. Please keep it confidentially. Your decisions will be anonymous and kept confidential. Thus, other participants won't be able to link your decisions with your identity. You will be paid in private, using your subject ID, and in cash at the end of the experiment.

You will participate in a series of games. In the end of the experiment, one game will be randomly drawn for payment.

When you have any questions, please feel free to ask by raising your hand, one of our assistants will come to answer your questions. Please DO NOT communicate with any other participants.

Game1

Subjects in this experiment will be randomly matched into groups. Each group consists of two players: player 1 is the firm owner, and player 2 is the consumer. The consumer will be endowed with $20.

If you are the owner of a company (we will randomly determine your role), your company's profit depends on which method of production process is chosen. You have three choices.

Choice 1
In choice 1, you will produce the product within the company, and you will earn a profit of $30. However, the production process will cause some pollution problem (which is represented by the fact that a consumer will lose $5).

Choice 2
In choice 2, you will produce the product within the company, using a technology that will not cause pollution problem, and you will earn a profit of $20.

Choice 3
In Choice 3, the production will be outsourced to another company, and you will earn a profit of $28. The outsourced company will then choose whether to carry out the production process in an environmental friendly way or one that will cause some pollution problem (which is represented by the fact that a consumer will lose $5).

Please make your choice now
If I am randomly chosen as the owner, I will choose:

o Choice 1 o Choice 2 o Choice 3

Game2

In each of the choices below, please choose between playing A versus B.

There are two bags. A card will be randomly drawn from your chosen bag.

In bag 1, there are 50 cards numbered from 1 to 50. That is, each number has one card. Your payoff will be equal to the number drawn.

In bag 2, there are 50 cards in total. Each card is marked with one number. The numbers are in the range of 1 to 50, but the exact distribution is unknown. Your payoff will be equal to the number drawn.

Please make your decision now.

Choice	A.	B.	Circle Your Choice
1	Bag 1	Bag 2	A B

Game3

In each of the choices below, please choose between playing A versus B.

There are two bags. A card will be randomly drawn from your chosen bag.

In bag 3, there are 50 cards numbered from 1 to 50. That is, each number has one card. Your payoff will be equal to the number drawn.

In bag 4, there are 50 cards in total. Each card is marked with one number. The numbers are in the range of 1 to 80, but the exact distribution is unknown. Your payoff will be equal to the number drawn.

Please make your decision now.

Choice	A.	B.	Circle Your Choice
1	Bag 3	Bag 4	A B

Game 4

In each of the choices below, please choose between playing A versus B.

There are two bags. A card will be randomly drawn from your chosen bag.

In bag 5, there are 50 cards numbered from 1 to 50. That is, each number has one card. Your payoff will be equal to the number drawn.

In bag 6, there are 50 cards in total. Each card is marked with one number. The numbers are in the range of 1 to 100, but the exact distribution is unknown. Your payoff will be equal to the number drawn.

Please make your decision now.

Choice	A.	B.	Circle Your Choice
1	Bag 5	Bag 6	A B

Game 5

Please choose to bet on the last digit of the closing of the Hanseng Index or Dow Jones Index on 1994-12-13.

If you choose to bet on Hang Seng index, you will win HK$20 if the last digit is 2 or 4 or 6 or 8, zero otherwise.

If you choose to bet on Dow Jones index, you will win HK$20 + $x if the last digit is 2 or 4 or 6 or 8, zero otherwise.

Please Choose:

Choice	A.	B.	Circle Your Choice
1	Hang Seng index	Dow Jones index +$0	A B
2	Hang Seng index	Dow Jones index +$1	A B
3	Hang Seng index	Dow Jones index +$2	A B
4	Hang Seng index	Dow Jones index +$3	A B
5	Hang Seng index	Dow Jones index +$4	A B
6	Hang Seng index	Dow Jones index +$5	A B
7	Hang Seng index	Dow Jones index +$6	A B
8	Hang Seng index	Dow Jones index +$7	A B
9	Hang Seng index	Dow Jones index +$8	A B
10	Hang Seng index	Dow Jones index +$9	A B
11	Hang Seng index	Dow Jones index +$10	A B

Game 6

Please choose to bet on the last digit of the closing of the Hanseng Index or Dow Jones Index on 1994-12-14.

If you choose to bet on Hang Seng index, you will win HK$20 if the last digit is 1, zero otherwise.

If you choose to bet on Dow Jones index, you will win HK$20 + $x if the last digit is 1, zero otherwise.

Please Choose:

Choice	A.	B.	Circle Your Choice
1	Hang Seng index	Dow Jones index +$0	A B
2	Hang Seng index	Dow Jones index +$1	A B
3	Hang Seng index	Dow Jones index +$2	A B
4	Hang Seng index	Dow Jones index +$3	A B
5	Hang Seng index	Dow Jones index +$4	A B
6	Hang Seng index	Dow Jones index +$5	A B
7	Hang Seng index	Dow Jones index +$6	A B
8	Hang Seng index	Dow Jones index +$7	A B
9	Hang Seng index	Dow Jones index +$8	A B
10	Hang Seng index	Dow Jones index +$9	A B
11	Hang Seng index	Dow Jones index +$10	A B

Game 7

Please choose to bet on the last digit of the closing of the Hanseng Index or Dow Jones Index on 1994-12-15.

If you choose to bet on Hang Seng index, you will win HK$20 if the last digit is 1 or 2 or 3 or 4 or 5 or 6 or 7, zero otherwise.

If you choose to bet on Dow Jones index, you will win HK$20 + $x if the last digit is 1 or 2 or 3 or 4 or 5 or 6 or 7, zero otherwise.

Please Choose:

Choice	A.	B.	Circle Your Choice
1	Hang Seng index	Dow Jones index +$0	A B
2	Hang Seng index	Dow Jones index +$1	A B
3	Hang Seng index	Dow Jones index +$2	A B
4	Hang Seng index	Dow Jones index +$3	A B
5	Hang Seng index	Dow Jones index +$4	A B
6	Hang Seng index	Dow Jones index +$5	A B
7	Hang Seng index	Dow Jones index +$6	A B
8	Hang Seng index	Dow Jones index +$7	A B
9	Hang Seng index	Dow Jones index +$8	A B
10	Hang Seng index	Dow Jones index +$9	A B
11	Hang Seng index	Dow Jones index +$10	A B

Game 8

Please choose to bet on whether the closing of the Hang Seng Index or Dow Jones Index on 1994-12-16 is higher than the previous trading day.

If you choose to bet on Hang Seng index, you will win HK$20 if it is higher, zero otherwise.

If you choose to bet on Dow Jones index, you will win HK$20 + $x if it is higher, zero otherwise.

Please Choose:

Choice	A.	B.	Circle Your Choice
1	Hang Seng index	Dow Jones index +$0	A B
2	Hang Seng index	Dow Jones index +$1	A B
3	Hang Seng index	Dow Jones index +$2	A B
4	Hang Seng index	Dow Jones index +$3	A B
5	Hang Seng index	Dow Jones index +$4	A B
6	Hang Seng index	Dow Jones index +$5	A B
7	Hang Seng index	Dow Jones index +$6	A B
8	Hang Seng index	Dow Jones index +$7	A B
9	Hang Seng index	Dow Jones index +$8	A B
10	Hang Seng index	Dow Jones index +$9	A B
11	Hang Seng index	Dow Jones index +$10	A B

Game 9

Please choose to bet on whether the closing of the Hanseng Index or Dow Jones Index on 1994-12-19 is lower than the previous trading day.

If you choose to bet on Hang Seng index, you will win HK$20 if it is lower, zero otherwise.

If you choose to bet on Dow Jones index, you will win HK$20 + $x if it is lower, zero otherwise.

Please Choose:

Choice	A.	B.	Circle Your Choice
1	Hang Seng index	Dow Jones index +$0	A B
2	Hang Seng index	Dow Jones index +$1	A B
3	Hang Seng index	Dow Jones index +$2	A B
4	Hang Seng index	Dow Jones index +$3	A B
5	Hang Seng index	Dow Jones index +$4	A B
6	Hang Seng index	Dow Jones index +$5	A B
7	Hang Seng index	Dow Jones index +$6	A B
8	Hang Seng index	Dow Jones index +$7	A B
9	Hang Seng index	Dow Jones index +$8	A B
10	Hang Seng index	Dow Jones index +$9	A B
11	Hang Seng index	Dow Jones index +$10	A B